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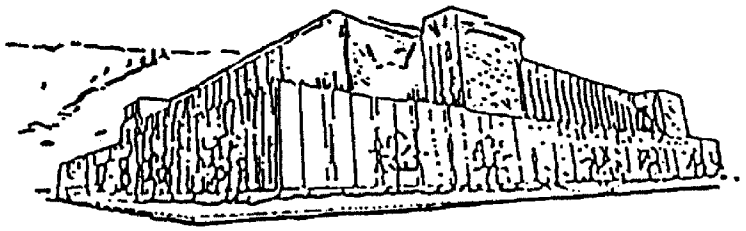

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A COMPARATIVE ANALYSIS OF THE MECHANISMS INVOLVED IN PARENT-INFANT INTERACTION BETWEEN DEAF AND HEARING DYADS

by

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A Comparative Analysis of the Mechanisms Involved in Parent-Child Interaction between Deaf and Hearing Dyads (38 pp.)

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This paper explores the development of the early infant-parent relationship and explores the mechanisms involved in these early interactions. The current study compares the frequencies of the communication behaviors between groups of deaf and hearing parents and their hearing or deaf infants across episodes of face-to-face (parent) and still-face interaction (infant matching) behavior across two different time periods. Of particular focus is the examination of the most frequent modalities reciprocated between deaf and hearing dyads. Hearing dyads rely upon vocal modalities and facial affect in their interactions. Deaf dyads rely upon facial, hand-finger, and general motor modalities. Results of this study indicate no significant differences in the groups' frequencies of interactions between parents and infants across the four groups, although some differences in patterns of interaction emerged in the data. However, significant differences across time and episode in all four groups, as well as significant differences between groups across time and episode emerged in the hand-finger behavior. This indicates that infants may be more responsive to visual cues emitted by their parents than previously thought.

A Comparative Analysis of the Mechanisms Involved in Parent-Infant Interaction Between Deaf and Hearing Dyads

This paper will explore the early parent-child relationship in order to understand how the social partnership affects the communication development of the child. In identifying the importance of the interactional piece of the attachment relationship, the individual contributions of the infant and mother to the relational construct will be discussed. Once the individual roles of parent and infant are explored, focus will shift to parent-child interactions between deaf and hearing dyads and the use of sensory modalities in their communication behaviors. Finally, those modalities will be analyzed according to how frequently those imitative communicative behaviors occurred between the dyads. Those frequencies will be analyzed and compared to determine if there are any significant differences in the communication strategies between the groups of deaf and hearing parents interacting with their deaf or hearing infants at both the six and nine month stages of development.

A critical developmental issue, which occurs in the first year of life, is the formation of an affective attachment bond between an infant and its mother (Egeland & Farber, 1984). Much focus has been given to the development of the attachment relationship between the parent and child (Bornstein & Lamb, 1992). Parent participation has always been considered an essential component in the attachment relationship (Kasting, 1994). The importance of parent involvement within the dyadic relationship is rarely questioned (Mangelsdorf, Gunnar, Kestenbaum, Lang & Andreas, 1990; Kasting,

1994). More controversial, is the definition of specific roles each contributes to the attachment relationship, and the importance of those contributions in later socio-communicative development.

Attachment can be defined as "the affectional bonds that infants form with care-givers and endure across time and situations" (Seifer & Schiller, 1995, p. 148). Seifer and Schiller (1995) also indicate that the most relevant feature of attachment theory is that during the first few years of life a secure base with an attachment figure will emerge. Interestingly, the development of a secure base means that the infant has an innate or conscious goal of determining the balance of relational distance (Seifer & Schiller, 1995). Furthermore, "attachment behaviors" in the infant are those behaviors which enable the infant to approach (movement) or signal the care-giver (smiling, vocalizing, or crying) and promote proximity to the care-giver. The attachment system has an external goal of motivating the infant to seek proximity to the care-giver, and an internal goal of motivating the infant to seek out security (Zeanah, Mammen, & Lieberman, 1993). A basic tenant of the attachment theory is that maternal behavior toward the infant is a crucial factor in the formation of that relationship (Bowlby, 1969; Ainsworth, 1978; as cited in Lowinger, Dimitrovsky, Strauss, & Molinger, 1995).

In an attempt to understand how a child learns to interact with others in a social environment, it is important to determine the effects of cognitive, communicative, and social experiences during the earliest years of life. Although the exact relationship of thought and language is still not adequately explained and completely understood, it is concluded that both play a significant role in learning to communicate symbolically at various stages of development (Owens, 1984).

There are many theoretical constructs that attempt to explain the complexity of early cognitive, social, and communicative development. These experiences influence language acquisition in the early childhood years. However, it is agreed upon that no single cognitive or socio-linguistic theoretical approach adequately explains how language is acquired early on in life. This discussion is beyond the scope of this investigation. However, it is of relevance to consider language development from a cognitive and social perspective in an attempt to understand how a child learns to communicate in his or her own environment. Early cognitive, social, and communicative bases in which language occurs can be understood by observing the natural occurrence of early communication development. To better understand some of the cognitive processes involved in infant learning and socialization, it is important to acknowledge the importance of the communication strategies of care-givers.

Early socio-emotional theories emphasize the communication of the infant with signals and the parent's predisposition to respond (Bowlby, 1969; as cited in Bornstein & Lamb, 1992). Although the infant is not passive and contributes a great deal to the relationship, the mother is expected to be more influential in the dyadic relationship (Belsky, Ravine, & Taylor, 1984; Goldberg, Perotta, Minde, & Corter, 1986; Sroufe, 1978; as cited in Lowinger, Dimitrovsky, Strauss, & Molinger, 1995).

Maternal working models of attachment (internal constructs) are related to the quality of interaction and child security. Eiden, Teti, and Corns (1995) indicate that these working models influence the parent child relationship well beyond infancy. The construct is conceptualized as an affective-cognitive mechanism within the mother and is related to that early relationship because of how it influences the child's world-view and

continuity in development later in life (Crnic, 1977).

Other mechanisms factored into the mother's role are the concept of maternal sensitivity to the infant's cues. Parent sensitivity and responsiveness have been directly related to secure or insecure infant attachment (Seifer & Schiller, 1995). It is further suggested that parents' insensitive responses to children did not facilitate or promote child language development (Gordon, 1970; as cited in Crnic, 1977). Parent sensitivity and responsiveness has been conceptualized as an effective demonstration of warmth and an awareness of the child's feelings (Crnic, 1977). Whether or not a parent is sensitive and responsive to infant emotion signals is an important factor in facilitating positive reciprocal interaction patterns. Thus, parents who misread the emotions of their infants are more likely to respond inappropriately to the infant (Kropp & Haynes, 1987). Nevertheless, the infants sustain the same developmental processes (Belsky, Spritz, & Crnic, 1996).

Research findings indicate that maternal behaviors crucial to relational formation are predominantly physical and social dimensions. In an attempt to determine which dimension is more crucial to relational formation, researchers have compared the two types of interaction. Eye to eye contact, vocalizations, and smiles are some of the social contacts mothers make with their infants (Call, 1975; Sander, 1975; Schaffer & Emerson, 1964; as cited in Lowinger, Dimitrovsky, Strauss, & Molinger, 1995).

There are sensory, motor, and affective elements in the input exchanged within the dyadic relationship. Sensory elements include maternal vocalizations, facial expressions, body movements, proxemics, and touch. The infant's motor behaviors enable him or her to modify experiences and to affect the mother's behavior. The

affective experience is derived from the infant and mother's joint regulation of the infant's states of attention, excitation, and emotion. Meaning is inferred by the child from the vocalizations and nonrandom behaviors of the mother in interactional situations and joint action routines, such as games, in which the child takes a particular role within the interaction (Bruner, 1975; as cited in Owens, 1984). These behaviors are systematically modified over a variety of naturally occurring situations to facilitate language and communication development over time.

On the other hand, the infant also contributes individual attributes to the relational system. As previously mentioned, the infant engages in signaling behaviors in an attempt to "teach" the care-giver about the development of the relationship (Seifer & Schiller, 1995). Even the gender of the infant may play a role in regards to preferences for dyadic interaction. Benenson (1993) examined sex differences in children's preferences for dyadic group interaction in early childhood. Results indicated a greater preference among females than males for dyadic interaction. Infant temperament also influences the quality of interactions between the infant and the care-giver (Seifer & Schiller, 1995).

According to the temperament perspective, certain intrinsic factors exist which may predispose a child to respond with distress to environmental stressors. In a study assessing temperament, the irritable, difficult to soothe infant was more likely to be easily distressed (Matheny, Reise, & Wilson, 1985). Thus, infant temperament is likely to influence parental patterns of response in the dyadic relationship. According to the temperament perspective, infant temperament is as significant as parent sensitivity (Mangelsdorf, Kestenbaum, Lang, & Andreas, 1990). The debate as to the proportion of infant and parent contributions to the dyadic relationship is even more perplexing when

the development of the attachment relationship between infant and parent, and the specific contributions of each is still not clearly understood and universally agreed upon.

The human infant is precocious in the early presence of the development of cognitive capacities. In fact, the infant's precocity is manifested in the infant's early abilities to abstract and conceptualize information across all sensory modalities with the use of symbols by the end of the first year of life. Over the first year, the infant's early behaviors acquire intentionality and have several communicative functions. The initial behavior of an infant communicates little beyond the immediate behavior itself. What makes those behaviors purposeful is the mother's response to those behaviors. Furthermore, mothers interpret infant behavior as meaningful communicative intent, and respond to those signals, thus providing the infant with an opportunity, or turn, for the infant to respond (Owens, 1984).

For the purpose of this paper, it may be of relevance to consider Piaget's contributions to the study of infant cognitive development. Piaget's theory posits a cumulative process in which each new behavior is acquired independently through shaping the environment. This constructivist theory implicates a bi-directional interaction between the individual and the environment, leading to a series of qualitative reorganizations in the cognitive system as a whole and reflects progress in how that individual makes sense of his or her world. Cross-age comparisons are made as a basis for inferring changes that occur in the cognitive system (Kuhn, 1992). It is of importance to consider Piaget's developmental stages when discussing the cognitive capacities of infants. This paper will focus on the Secondary Circular Reactions (four to eight months) and the Coordination of Secondary Circular Reactions (eight to twelve months) stages of

infant cognitive development (Bailey & Wolery, 1989).

In the Secondary Circular Reactions stage (four to eight months), children become aware that they can have an effect on their environment, and that their actions can produce pleasurable results. At this stage, the infants begin to repeat those behaviors to continue the pleasurable reactions. The infants' relationship between perceptions and their manual activities is more accurately felt with prehension becoming distinct from forearm gestures. However, the infant only focuses on the results of the actions rather than on the action itself. Therefore, discoveries are random with no pre-established goal in mind (Bailey & Wolery, 1989).

The most outstanding feature of the Coordination of Secondary Circular Reactions stage (eight to twelve months) is that children learn to become goal-directed. An infant in this stage can chain behaviors together to achieve a desired goal. However, if attempts to accomplish a desired result are ineffective, they appear to have no alternative recourse available, and do not try a new way of reaching the goal because at this stage an infant is limited to familiar behavioral schemes (Bailey & Wolery, 1989).

Recent studies have indicated that young infants are more proficient imitators than previously thought (Meltzoff, 1985). *Imitation* can be defined as "the process of copying the behavior of others". Moreover, imitation tends to be used with a sense of intentionality, meaning the one imitating wants to model the actions of another (Reber, 1995). Studies show that infants can imitate the facial gestures of the care-giver within the first month of life (Meltzoff & Moore, 1977; 1983; Jacobsen, 1979; Field, Woodson, Greenberg, & Cohen, 1982; as cited in Meltzoff, 1985). Spencer (1993) examined the effect of maternal signing on the infants' development of language, and a strong

correlation was determined between maternal and infant sign production. This indicates the bi-directional influence of parent-child reciprocal interaction. As previously stated, not only is the infant giving the parent cues about how the relationship will be, but the parent is also modeling to the infant how to imitate and read parental cues.

For the purpose of this paper, *communication* is a broad construct which includes "any behavioral act, whether intentional or unintentional, that influences the behavior, ideas, or attitudes of another person" (Prizant, Wetherby, & Roberts, 1993). In other words, communication is the transmission of something from one location to the other. Transmitted may be a message, signal, or meaning. In order to have communication, both parties must have a common code so that meaning or information contained in the message can be interpreted without error (Reber, 1995). *Language* is a "complex, conventional system of arbitrary symbols that are combined and used in a rule-governed manner for communication" (Lahey, 1988; as cited in Prizant, Wetherby, & Roberts, 1993). One mode for the expression of language is speech, which involves a production (expressive) and reception of vocal signals. Expressive communication refers to the ability to produce vocalizations, gestures, or speech. On the other hand, receptive communication is distinguished by the ability to receive and comprehend the communicative signals from others (Prizant, Wetherby, & Roberts, 1993). Communication is based in the behavioral rhythms of the two partners and mutual adaptation (Thoman, 1981; as cited in Stafford & Bayer, 1993). The assumption is that the parties are operating from the same modalities. A *modality* is a sensory system (e.g. visual, audiological, or kinesthetic) (Reber, 1995).

Another definition which focuses on the communication modality of persons with

deafness is the idea that the communication development and primary communication is visually based (sign language, and/or lipreading). Residual hearing (if any) is a secondary and supplementary sensory avenue. Visual cues are the main channel by which a person with deafness receives information about the environment (DiPietro, 1995).

Mother-infant face-to-face interactions often resemble a conversation in that each member of the dyad appears to be responsive to the other, either by imitating or by signaling (Cohn & Tronick, 1988; as cited in Bornstein & Lamb, 1995). Infants begin to learn the rule of *reciprocity*, which refers to the partners' turn-taking interactions. In this mutual exchange is the notion of equal give and take in their communications (Reber, 1995). The primary feature of social interaction in infancy, turn taking, provides a discourse structure without which the rules of language could not be learned. The basic premise of language and communication is based upon the routines that are predicated on a turn-taking structure. Turn-taking is inherent to interpersonal communication (Stafford & Bayer, 1993). Infants also learn *effectance*, which indicates that they understand that they can effect the behavior of others. As a result, they learn to *trust*, because they learn that their parents can be counted on to respond when signaled (Bornstein & Lamb, 1995).

The phenomenon of turn-taking in communication has been intensively studied in adult-adult interaction under such labels as bi-directionality, synchrony, and reciprocity (Cappella, 1981; as cited in Stafford & Bayer, 1993). *Synchrony* is the dyad bringing together of various disparate aspects in a more or less coordinated manner, so as to produce a more unified single system (Reber, 1995). Synchrony, in turn-taking, has also been called conversational congruence, symmetry, pattern matching, and coordinated

personal timing of responses. Many scholars agree that early communication, although it may not be intentional, is synchronous and mutually influencing. Studies of interactional synchrony best demonstrate the impact of nature on parent-child communication (Dimitracopoulou, 1990; as cited in Stafford & Bayer, 1993). In other words, infants are biologically predisposed to be social and communication ability appears to be innate and expressed quite early, which impacts the mother. The infant may be biologically predisposed to turn-taking activities. Studies have consistently documented the synchronous nature of neonate and infant actions. A strong case for the importance of synchrony, or the lack of synchrony is made by Cappella (1991), who proposed that parents and children who are biologically predisposed to different physiological rhythms will be out of synch in their interaction patterns (Stafford & Bayer, 1993). Asynchronous interactions may also influence cognitive development (Welkowitz et al., 1990; as cited in Stafford & Bayer, 1993).

Research Questions

When a child is born with severe permanent deafness to hearing parents or a hearing child is born to deaf parents, the question of how the parents will communicate with their baby arises. In review of the literature, in which the bi-directional reciprocal effects of parent-infant relationships are examined with deaf and hearing parents and their deaf or hearing children, it has been theorized that those qualities which contribute to synchrony and mutuality between the two partners, are more difficult to establish when the usual vocal channel is not available. Behaviors such as turn-taking , eliciting and maintaining attention, and expressing emotion may all be dependent upon the vocal modality between hearing partners. However, when a parent or infant is deaf, similar

face-to-face interactive patterns must be developed through alternative modalities (Koester, 1994). Thus, what are the implications, if any, for dyads operating from different sensory modalities? Studies of deaf infants and either deaf or hearing parents have indicated that the reciprocal interaction process is altered when auditory /vocal communication is not available (Gianino & Meadow-Orlans, 1987; as cited in Koester, 1994).

Results of another study indicate that there is a greater reliance on visual modalities among deaf mothers whereas hearing mothers utilized vocal modalities, regardless of infant hearing status (Koester, Karkowski, & Traci, 1998). With early interaction being primarily vocal in hearing mothers with deaf and hearing infants, the premise of this paper is to gather information regarding how mothers compensate when the child has an inability to attend to those vocal cues. When a parent or an infant has a hearing loss, both partners are expected to develop a compensatory reliance on other communication modalities (Koester, 1992; 1994). It is suggested that deaf parents may intuitively offer insight into initiating and maintaining a deaf infant's attention (Koester, Karkowski, & Traci, 1998).

Therefore, what are some of the compensatory behaviors for those dyads in which either the mother or the infant have deafness? For deaf infants, visual and tactile modalities would be the most important in order for them to gain information about the environment. Alternatively, their hearing counterparts are utilizing auditory and visual modalities to explore the world. With synchronous communication involving the flow of back-and-forth interactions, what differences and similarities exist for those "mixed dyads" operating from different sensory modalities? Would their communication be as

synchronous as their matched counterparts?

Behaviors such as turn-taking, initiation, and maintenance of the interaction may be highly dependent upon visual attention or alternative modalities. Deaf infants with hearing parents (and vice versa) are faced with the challenge of having to interact with a caregiver whose usual mode of communication is via a sensory modality not accessible to them. This is of considerable interest if one considers that most deaf infants have hearing parents (Koester, 1994). Therefore, it is expected that those dyads will experience fewer synchronous and reciprocal interactions, than those dyads that are matched (hearing parent with a hearing child and/or deaf parent with a deaf child).

Reciprocal interactions with the care-giver over the first year enhance the probability of the infant being securely attached by the first year. As previously discussed, the conceptual link between early maternal responsiveness and infant competence has been looked at in terms of a "secure base phenomenon" (Sroufe & Waters, 1977). This illustrates the idea that a mother who is responsive and accessible to her infant enables the infant to securely separate and explore the environment.

The development of language is one of the most impressive accomplishments of early childhood. It is a complex process that occurs regardless of the infant's inability to think abstractly. Current language theories consider both innate ability and verbal experience to be of utmost importance for language learning. The remarkable speed and manner in which children begin to master the language of their community indicates that infants are ready for social interaction from birth. Even very young babies possess an impressive array of perceptual abilities and behavior patterns, which function to ensure the proximity of their caretakers, and to ensure opportunities for communication

(Ainsworth, Behar, Water, & Wall, 1978; Bowlby, 1969; Schaffer, 1977; and Bell, 1973; as cited in Barnard, Morisset, & Spieker, 1993).

Studies of neonatal capabilities reveal an elegant interface between the structural and functional capacities for the newborn and early social experience. For instance, within moments after birth, infants demonstrate auditory as well as visual sensitivity to the stimuli of human interaction. If they are hearing babies, they are even perceptually attuned to the range of sounds in the human voice, and can discriminate speech sounds on the basis of vocalizations and articulations (Eisenberg, 1969; Eimas, Siqueland, Jusczyk, & Vigorito, 1971; Trehub & Rabinovitch, 1972; as cited in Barnard, Morisset, & Spieker, 1993).

A parent's ability to communicate with their infant is one of the most important ways to establish a good relationship, and is crucial for the child's ability to learn language. Studies demonstrate that infant behavior is organized into patterns of inherent rhythms, and that the flow of early dyadic interactions seems largely dependent upon mothers' ability to insert themselves into these rhythms. These rhythms of very early exchanges resemble conversational dialogue (Barnard, Morisset, & Spieker, 1993). Research has demonstrated that when hearing mothers use speech and sign language with their deaf children, there is more time spent in interactive play activities, and more complex communication being dyadically exchanged. Also, children with deafness in this group were more sociable and cooperative with their mothers, and were able to maintain eye contact longer than the deaf children with hearing mothers who were using only oral communication (Schwartz, 1987).

Studies have also shown that mothers of deaf infants appear to offer more

stimulation and focus on more objects than social play. Additionally, hearing mothers of deaf infants display less affective matching and responsiveness than do mothers of hearing infants (MacTurk, Meadow-Orlans, Koester, & Spencer, 1993). Longitudinal studies of individual children have indicated that deaf children who were exposed to signs as well as oral communication early in their lives used their first signs at ten months of age, which is when hearing babies begin to pronounce their first words.

This is not an investigation into the actual language development of deaf or hearing children, but rather a comparison of the behavioral attributes to which they are exposed to in their earliest environmental experiences with their deaf or hearing caregivers. It is beyond the scope of this paper to investigate causality of the methods or modalities incorporated by either partner in the dyadic pair. The purpose of this paper is to compare the communication behaviors emitted between groups in order to determine if there are any differences or similarities between groups according to hearing status, episode, and across time.

Methods

The present study is designed to determine the differences and similarities in communication styles between groups of deaf and hearing dyads using different sensory modalities at two different testing periods. The frequencies of their imitative actions were compared to determine what variables, if any, are involved in their turn-taking interactions.

It was predicted that in the "mixed dyads" (**H**earing parent/**D**eaf infant and **D**eaf parent/**H**earing infant) the infant's imitations would be less frequent than the "matched dyads" (**H**earing parent/ **H**earing infant and **D**eaf parent/ **D**eaf infant). It was also

proposed that the communication behaviors emitted in the "mixed groups" would be asynchronous in comparison to the "matched groups". Synchrony was measured by analyzing the frequencies of mother and infant reciprocal behaviors while they were engaged in face-to-face interaction, transition, and still face settings across two different time periods. The frequency of the infant's imitative behaviors elicited from the face-to-face interaction episode and the still-face episode was the focus of examination across two different time periods (six months and nine months) in the first year of the infant's life.

Data Collection

Mother-infant interaction was videotaped in a laboratory setting using the standard face-to face paradigm (Mayes & Carter, 1990), with the baby and mother facing each other and engaged in play for three minutes; this was followed by a 30 second transition (with mother facing to side); and a maternal "Still-Face" episode for two minutes which was followed by two minutes of resumed face-to-face interaction play. The interactions were videotaped and coded separately for mothers and infants using a coding scheme to record frequency of both maternal and infant imitative behaviors in the following categories: ***vocal/verbal matching; head movement/gaze matching; exaggerated affect/facial matching; general motor matching; and hand-finger/gesture matching***. Data were gathered to reflect patterns of the above mentioned sensory modalities utilized by both deaf and hearing mothers when their deaf or hearing infants were at the six-month-old, and again at the nine-month-old stages of development. Collected data were used to compare ways in which the mothers' utilization of sensory modalities varied according to infant hearing status.

Participants

This research was from a longitudinal study at Gallaudet University, and all of the parents with deafness were recruited on site. In this study, the mothers with deafness identified with the deaf culture and were already using American Sign Language (ASL) with their infants. American Sign Language is "the system of gestures, hand signals, and finger spelling used by the deaf culture in North America" (Reber, 1995). Dyads were videotaped in face-to-face interaction when the infant was at two different stages in development: ***Time 1*** **(T1)**, six-months-of-age, and again at ***Time 2*** **(T2)**, nine-months-of-age. Sixteen infants and their mothers were observed. Each of the dyads are grouped according to hearing status. The four groups are classified as follows: ***Group 1*** *= Deaf parent/Deaf infant* ***(D/D)****, n=4;* ***Group 2*** *= Hearing parent/ Deaf infant* ***(H/D)****, n=4;* ***Group 3*** *= Deaf parent/ Hearing infant* ***(D/H)****, n=4; and* ***Group 4*** *= Hearing parent /Hearing infant* ***(H/H)****, n=4.* Groups were matched for maternal education (mean years of schooling = 16.3). Subjects were primarily from middle-income level Caucasian families. In addition, all fathers were present in the home and of the same hearing status as the mothers. However, for the purpose of this study, only mother-infant data were examined. The infants in this study had been given the diagnosis of profound deafness. Because of hearing aids, hearing could be amplified in some instances. It is of significance to note that the infants with deafness in this examination were diagnosed at a very early age and had never been exposed to verbal language. Due to advanced audiological technology, early diagnosis has been made possible. This is of significance to note because in the past, hearing loss was usually detected later on in the toddler stages, having been discovered because of what a child was failing to do (Quin, 1996).

Having a hearing loss detected early on may assist parents in gathering information about and responding more intuitively towards their infant, on a trial and error basis.

Procedures

This study was set up similarly to other such studies. Mother-infant interaction was videotaped in a laboratory setting from behind a one-way observation mirror. The mother sat in a chair facing the infant, who sat in an infant seat positioned upright at a 45 degree angle with the baby facing the mother. The infant seat was placed on the table at the mother's eye level. No other objects were present in the room.

Mother and baby engaged in normal play for three different episodes: ***Episode 1 (E1)***, they were instructed to engage in three minutes of face-to-face interaction, followed by a 30 second **Transition** (with mother turned 90 degrees to the left side of baby); ***Episode 2 (E2),*** two minutes of still-face (mother faces infant with flat affect); and ***Episode 3 (E3),*** two minutes of resumed normal face-to-face play. For the still-faced sequence, mothers were instructed to maintain an affectively neutral or expressionless face for two minutes while looking at their infants, even if the infant began to cry. However, the participants were assured that the session would not continue if the infant became too distressed. For the purpose of this study, examination of imitative behaviors will only include the first two episodes of face-to-face interaction.

The video camera was placed behind a one-way mirror, and only the infant was taped during the still-face sequence. However, the play sessions and the transition period recordings included both the infant's and the mother's responses. Each episode was indicated by an investigator who entered the room and cued to the mother to begin the next session.

Coding

Early affective responses provide communicative signals for the adult regarding the infant's responsiveness and indicate the infant's use of internal or external regulatory mechanisms (Mayes & Carter, 1990). In studying the still-face situation, several variables were coded. After watching a series of sample pilot sessions, global descriptors were defined categorizing the still-face sequence. The categories were defined to describe qualitatively a progression in the type of responses from little visible response, to withdrawl of maternal attention, to active attempts at engagement to determine whether or not the infant was imitating games that he or she was playing with the mother.

Videotapes were coded separately for mothers (Episode 1) and infants (Episode 2) using a coding scheme to record the frequency of both maternal and infant behavior in the following categories: ***vocal/verbal matching; head movement/gaze matching; exaggerated affect/facial matching; general motor matching;*** **and** ***hand/finger or gesture matching. Vocal/verbal matching*** behaviors were defined as: sounds; laughs; vocalizations; vocal play; 'motherese'; cooing; and speaking. ***Head movement/gaze matching*** behaviors considered were: eye contact, and head shaking or nodding. ***Exaggerated affect/facial matching*** behaviors were determined by any affective expression. ***Motor matching*** behaviors were defined as: games (e.g. patty-cake); actions mom did with baby (e.g. touching foot, lifting arm, and etc.); taps; strokes; brushes; and moves. ***Hand/finger matching*** behaviors were: waving hands, sign-language, gestures, and pointing. Each behavioral event or series of events is coded as one behavior. Therefore, any behavior that the mother performed in the natural face-to-face play episode which the child imitated at least once in the second episode would be considered matching

behavior.

The researcher was responsible for coding the data in this study. The coder was also responsible for establishing acceptable levels of reliability for their respective measures, with two other coders. All sessions were coded by observers who were trained prior to the coding. For the training procedure, four videotapes were assessed by the coders. Intra-rater reliability was determined by agreements on coding each behavioral event. There were computations of 80 percent agreement across the coders.

For the analysis, summary variables were created to reflect maternal reciprocity (care-giver repeating or approximating the infant's previous behavior) during face-to-face interaction. Furthermore, summary variables were created to reflect infant social reciprocity (baby repeating or approximating the care-giver's matching of behavior or previous interactive pattern or sequence to gain or maintain care-giver attention) during transition and still-face episodes.

Event 1 - Vocal /Verbal Behavior

A 4 x 2 x 2 analysis of variance (ANOVA) was conducted with a between subjects factor by Group (D/D, D/H, H/D, & H/H), with a dependent factor of Episode (E1, E2), and a repeated measure of Time (six and nine months). Results showed a main effect of Episode and Time. When the means were examined, there were more occurrences of vocal/verbal behavior in Episode 2 (infants) than in Episode 1 (mothers). Looking across time, there were more occurrences of this behavior at Time 2 (nine months) than at Time 1 (six months). These results are visually presented in Figure 1.

Event 2 - Head Movement Behavior

A 4 x 2 x 2 ANOVA was conducted with a between subjects factor of Group, a

dependent factor of Episode, and a repeated measure of Time. There were main effects of Episode and Time with an interaction of Episode by Time that approached significance. Analysis of the main effect of episode, reveals a decrease in the occurrences of this behavior from Episode 1 to Episode 2. Further analysis reveals a large increase in the occurrences of this behavior from Time 1 to Time 2; including significant main effects. Within each time period, the occurrences decrease from Episode 1 to Episode 2. If time is held constant, and paired–samples t-tests are conducted, the findings are significant. At the six-month stage (Time 1) , mothers' responses (Episode 1) compared to infants' responses (Episode 2): ($t(15) = 2.162$, $p = .047$). At the nine-month-stage (Time 2), mothers' responses (Episode 1) compared to infants' responses (Episode 2): ($t(15) = 2.143$, $p = .049$). It appears, as shown in Figure 2, that this interaction is increasing in magnitude at each time period. For example, note the decrease at Time 2 from Episode 1 to Episode 2. Both decreases were significant.

Event 3 - Facial/Affect Behavior

A 2 x 2 ANOVA was performed with a between subjects factor of Group, a dependent factor of Episode, and a repeated measure of Time, there were main effects of Episode and Time with an interaction of Episode by Time. Since the interaction was clearly significant, Episode by Time was examined. From Time 1 to Time 2, the average number of facial/affect behaviors increased significantly. The main effects demonstrate that within each time period, the occurrences decrease from Episode 1 to Episode 2. If time is held constant, and paired-samples t-tests are conducted, both are significant. At Time 1 (six months), Episode 1 (face to face interaction) compared to Episode 2 (still-face): ($t(15) = 2.566$, $p = .022$). At Time 2 (nine months), Episode 1 compared to Episode

2: ($t(15) = 4.915$, $p<.001$). The differences in magnitude at each time period also appear. The decrease at Time 1 from Episode 1 to Episode 2 appears to be less than the decrease at Time 2 from Episode 1 to Episode 2. As displayed in Figure 3, both decreases were significant, but the amount of decrease was different.

Event 4 - General Motor Behavior

A 4 x 2 x 2 ANOVA was completed with a between subjects factor of Group, a dependent factor of Episode (E1, E2), and a repeated measure of Time (T1, T2). As seen in Figure 4, the main effect and interaction terms show that only a main effect of Time emerged as significant.

Event 5 - Hand/Finger Behavior

A 4 x 2 x 2 ANOVA was conducted with a between subjects factor of Group, a dependent factor of Episode (E1, E2), and a repeated measure of Time (T1, T2). As shown in figure 5, this was the most complicated analysis given that the Episode by Time by Group interaction term was significant. This suggests differences within the four groups by Time and Episode, as demonstrated in Figure 6.

When looking at Group 1 (***D/D***), there is a marginal effect of time and of episode by time. Time Main Effect, $F(1,3) = 24.250$, $p = .051$; Time and Episode Interaction, $F(1,3) = 42.250$, $p = .036$. This suggests that the only change for Group 1 (***D/D***) was for Episode 2 over time.

When looking at Group 2 (***H/D***), there was an effect of Episode, Time and Episode by Time Interaction. There were no differences between the episodes at Time 1, but there were differences at Time 2. The occurrences of hand/finger behavior for Episode 1 were substantially greater at Time 2 and those for Episode 2. Furthermore, Episode 1

increased over time, but Episode 2 did not.

The third Group (***D/H***) showed a marginal main effect of Episode and no other effects. Although there was an increase in the frequency of hand/finger behavior from Time 1 to Time 2, this increase was only marginally significant. When the individual t-tests are examined, they show that the only marginally significant change was with Episode 2 from Time 1 to Time 2.

For Group 4 (***H/H***), there was a main effect of Time and an interaction of Episode by Time. This interaction is the result of there being no change in the Episodes at Time 1, but a significant change at Time 2. This follows from a significant increase in Episode 2 from Time 1 to Time 2. This is also visually demonstrated in the four graphs on Figure 7.

Therefore, results indicate no significant differences between group frequencies of interactions between parents and infants in each individual behavior modality category. However, heightened significant differences were found across time and episode in all four groups. Furthermore, in the hand/finger behavior category, there are significant differences between groups and across time and episode. This may suggest that both deaf and hearing infants may be more responsive to visual gestures than previously thought.

Discussion

There is limited research regarding the interaction patterns between deaf and hearing infants and their deaf or hearing parents, this study is based upon the underlying premise that mother infant interactions are bi-directionally influenced. Research has not yet indicated the specific contributions regarding the influence of social, cognitive, and communicative effects of infant development on the reciprocity and synchrony of parent child interactions when the child or parent may be communicating via different sensory

modalities.

The research in this study did not support the hypothesis. The study predicted that there would be less frequent behavioral imitations across episode and time, in those groups in which the parent and infant were operating from different sensory modalities when engaged in turn-taking behavior. There were no significant differences found regarding the average occurrences of imitative matching behaviors between the "mixed dyads" and the "matched dyads" across the two different time periods. The pattern that emerges here is that it is not why or how the infant and their mothers are communicating through different sensory modalities, but that they are utilizing any modality they may have access to. This idea is in agreement with the notion of those "mixed dyads" relying upon those compensatory modalities (Koester, 1992; 1994). What is important here is the idea that the infant is responding back regardless of the modalities being utilized by their mothers.

An interesting finding in this particular study was that the infants across all of the groups were more frequently matching the hand-finger behavior of their mothers over the time periods. In fact, the hand/finger matching in all groups increased over time. The hand /finger imitation in the matched groups (***H/H, D/D)*** was more frequent than in the mixed groups (***D/H, H/D***). This could be explained by the idea that infants may be more innately responsive to gestural behaviors, and may even be displaying some primitive sign language imitation skills, just as hearing infants imitate mothers' vocalizations during the first year of life. Another pattern that emerged was the frequency of vocal imitative behaviors in both deaf and hearing infants with hearing parents. One explanation could be that hearing mothers who rely on mostly vocal modalities are reinforcing the vocalizations in these infants by responding in a favorable way each time the infant makes a

vocalization. It is also worth mentioning that patterns indicate more facial imitation in the matched dyads than in the mixed dyads. Future research could examine the effect on social-emotional development for the infants in those mixed groups. It is suggested that deaf parents may offer more intuitive insight into initiating and maintaining a deaf infant's attention (Koester, Karkowski, & Traci, 1998).

Some compensatory behaviors for those dyads in which either the mother or the infant have deafness are: visual, facial, and tactile modalities. These modalities would be the most important in order for the infants to maximize the information gained from the environment, whereas their hearing counterparts would be utilizing aural, and visual modalities to gain more information about their environments. The results of this study support the idea that both dyads could rely on the visual modality as well as incorporating gestures into the routines to help the infant maximize the information gained from their environments. Furthermore, it is of extreme significance to recognize the importance of the infant and parent contributions to the dyadic pair. However, the most important point of this study is that the parents and infants are responsive, not the modalities used or the differences in sensory capacities of the dyadic pair. This is important because it implies that compensatory behaviors are being utilized to maximize the information the infant receives from his or her environment. Information regarding parent interventions at the six and nine month stages of infant development was not available. It would be interesting to determine in future studies if any changes in time were due to involvement in early intervention programs.

A possible confound in this study could be subject selection. Sample size could have created a power problem such that no differences are found to be significant. This

study, because of its small sample size, therefore may not be representative of the general population as a whole. Furthermore, the Figures visually show that there were differences, but due to sample size, these differences may not be of significance. It is also of importance to note that another type of analysis could change the findings.

Another confounding variable may be in the coding of the tapes. The coder was privy to the hypothesis. For example, sometimes a hearing-aid on the infant or mother was visible or audible (beeping sounds recorded) in the tapes, and therefore apparent to the coder which dyads included a person with deafness. Also, a possible confound may be that the subjects were observed in a laboratory or controlled setting versus a more naturalistic setting. Although attempt was made to control intervening variables as much as possible, the infant or the parent may not have been behaving in a typical manner (e.g. awareness of the presence of the video-camera, or the unfamiliar environmental surroundings).

Research in this area has provided valuable information toward the understanding of communicative interactions between mothers and their infants, when one party is deaf, and they are operating from different sensory modalities. Studies in this area provide us with further information regarding the individual differences and similarities in infant cognitive and socio-emotional development early in life. More research could be done in regards to the understanding of turn-taking behavior between infants and their mothers encompassing cross-cultural, gender, and socio-economic comparisons. Further research could be conducted in an attempt to determine how an asynchronous pattern may influence the relationship between a deaf or hearing infant and their deaf or hearing care-giver. Also, most studies do not take into account the specific contributions that fathers make regarding

turn-taking behavior.

Conclusion

Very early in life, we all begin to develop and understand language as it occurs in the social environment in which we live. In the past, infants were viewed as being pre-linguistic and incapable of communication, since they did not emit expressive language. Parent-child interaction is often accorded an assisting role in the emergence of the child's language and communication skills. Their interchanges are clearly interactive in nature. In the past, the adult was seen as the critical guide in this process, and was credited the lead role. It is now recognized that pre-speech communication over the course of the first year enables a child to acquire and develop a more complex language system later on. Studies have consistently focused on the synchronous nature of neonate and infant actions. Early interactions are generally synchronous in nature. In sum, the infant may be biologically predisposed to turn-taking activities (Stafford & Bayer, 1993).

In western cultures, research has confirmed the importance of reciprocity, turn-taking, and synchronization in the parent-child relationship. However, what is not clear is the issue of individual relative contributions of mother and child. It is still not known exactly how much of the interaction is imposed by mothers' individual contributions versus how much is attributed to innate properties of the child (Stafford & Bayer, 1993). A strong case for the importance of synchrony, or the lack thereof, is made by Capella (1991; as cited in Stafford & Bayer, 1993) who proposed that parents and children who are biologically pre-disposed to different physiological rhythms will be out of sync in their interaction patterns. This is speculated to lead to difficulty in laying the foundation building blocks of communication. Asynchronous interactions may also influence

attachment formation between parent and child, as well as the child's cognitive development (Stafford & Bayer, 1993).

In summary, looking at the mechanisms involved in the formation of the parent-child relationship early on in life is of extreme significance. A discussion of the impact of turn-taking behaviors on the attachment relationship or early childhood language development is beyond the scope of this paper. However, it was worth mentioning the fundamental concepts of attachment because the examined time period encompasses the formation of the early parent-child relationship. The process of attachment begins to occur in the first year of life and continues until later on in the child's development. The mechanisms involved in the formation of the attachment relationship and the debated contributions of infant signaling, gender, temperament, and maternal sensitivity were also discussed. Considerations for deaf parents with hearing children and vice versa were illustrated and an investigative design was introduced as an attempt to understand some of the processes involved in the formation of the communicative relationship in those dyads operating via different sensory modalities.

After discussing the individual contributions of parent and infant in the early stages of relationship formation, the current study investigated the differences in the mechanisms involved in the interactions between deaf and hearing dyads. More specifically, this study proposed that the interactions between those "mixed dyads" operating from different sensory modalities (hearing parent and deaf infant, or deaf parent and hearing infant) would be less synchronous in comparison to those "matched groups" utilizing similar modalities (deaf parent and deaf infant, or hearing parent and hearing infant). This study proposed that behaviors emitted between those mixed groups would be significantly

less frequent than their matched counterparts. A comparisons test was used to determine if there were any differences in or between those groups in which there is a reliance on a sensory modality compared to those that rely on similar modalities across the two time periods. However, no significant differences were found regarding the modalities used or the sensory capacities of the dyadic pair. This could be supported by studies indicating that there is a reliance on compensatory modalities (Koester, 1992; 1994). Only time and episode were found to be the most significant indicators of frequent matched behaviors, which could be explained by the infants intuitively becoming more accustomed and adapted in their environments over time. The most significant finding here was the frequency of the observed infants' hand/finger imitation in all of the compared groups across time. This is significant because this indicates an innate ability for all infants, regardless of hearing status, to imitate hand-finger gestures of their parents. Moreover, this also suggests that infants may be more responsive to gestural than vocal cues emitted by their parents, regardless of the partners' hearing status. Therefore, it is further speculated that hearing parents could maximize the dyadic relationship, and perhaps influence their deaf child's communicative and cognitive development by using the hand-finger modality in combination with the vocal modality to elicit imitative behavior.

In conclusion, the current study explored the development of the early infant-parent relationship and explored some of the mechanisms involved in those early interactions. Individual infant and parent contributions to the dyadic pair was presented. The current study compared the average occurrences of the communication behaviors between groups of deaf and hearing parents with their deaf or hearing infants across two episodes of face-to-face interaction and infant matching behavior across the six and nine month stages of

infant development. Particular focus was given to the examination of the most frequent modalities reciprocated between deaf and hearing dyads in which one of the partners was utilizing a different sensory modality. Results of this study indicated no significant differences between the groups, although some patterns of interaction emerged from the data. Significant differences were found across time and episode in all four groups. However, the most significant differences were found across time and episode in the hand-finger behavioral event. Possible intervening variables to the study were portrayed, and ideas for future research were presented.

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Figure Caption

Figure 1. Average frequencies of vocal/verbal behaviors emitted by mothers and infants in the four groups at the six and nine month period.

Event 1 – Vocal/Verbal Behaviors

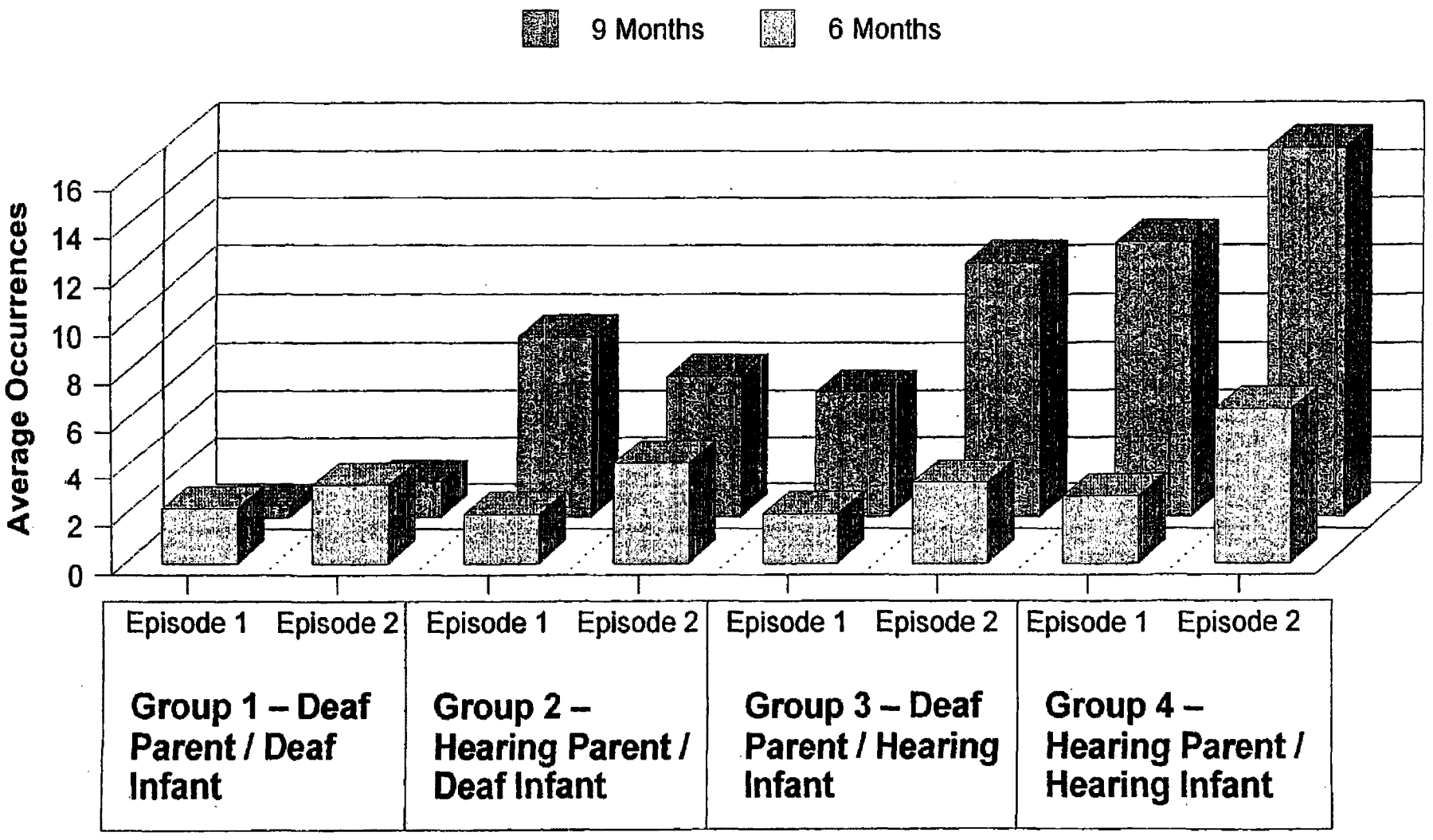

Figure Caption

Figure 2. Average frequencies of head movement behaviors emitted by mothers and infants in the four groups at the six and nine month period.

Event 2 – Head Movement Behavior

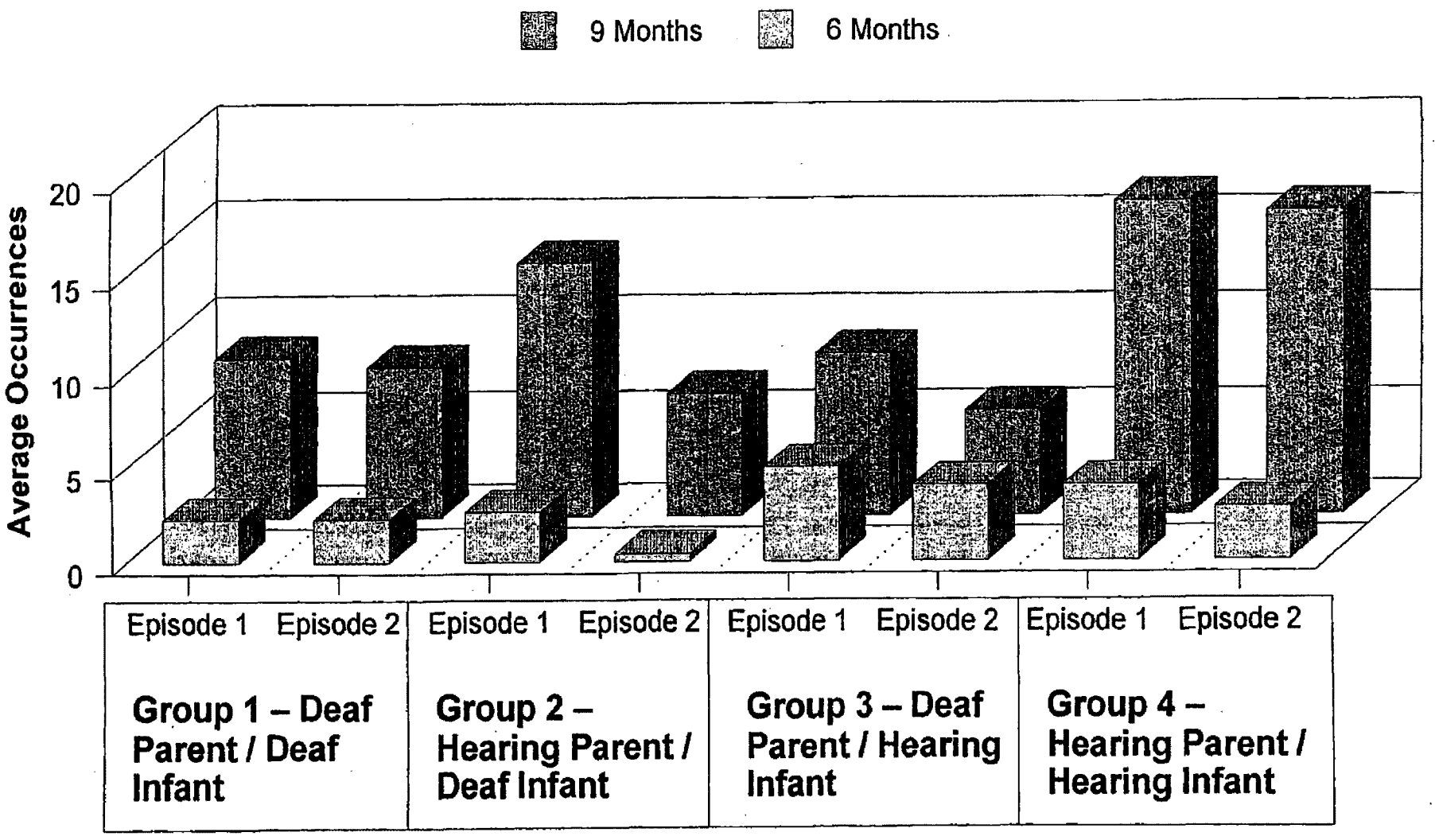

Figure Caption

Figure 3. Average frequencies of facial affective behaviors emitted by mothers and infants in the four groups at the six and nine month period.

Event 3 – Facial Affective Behavior

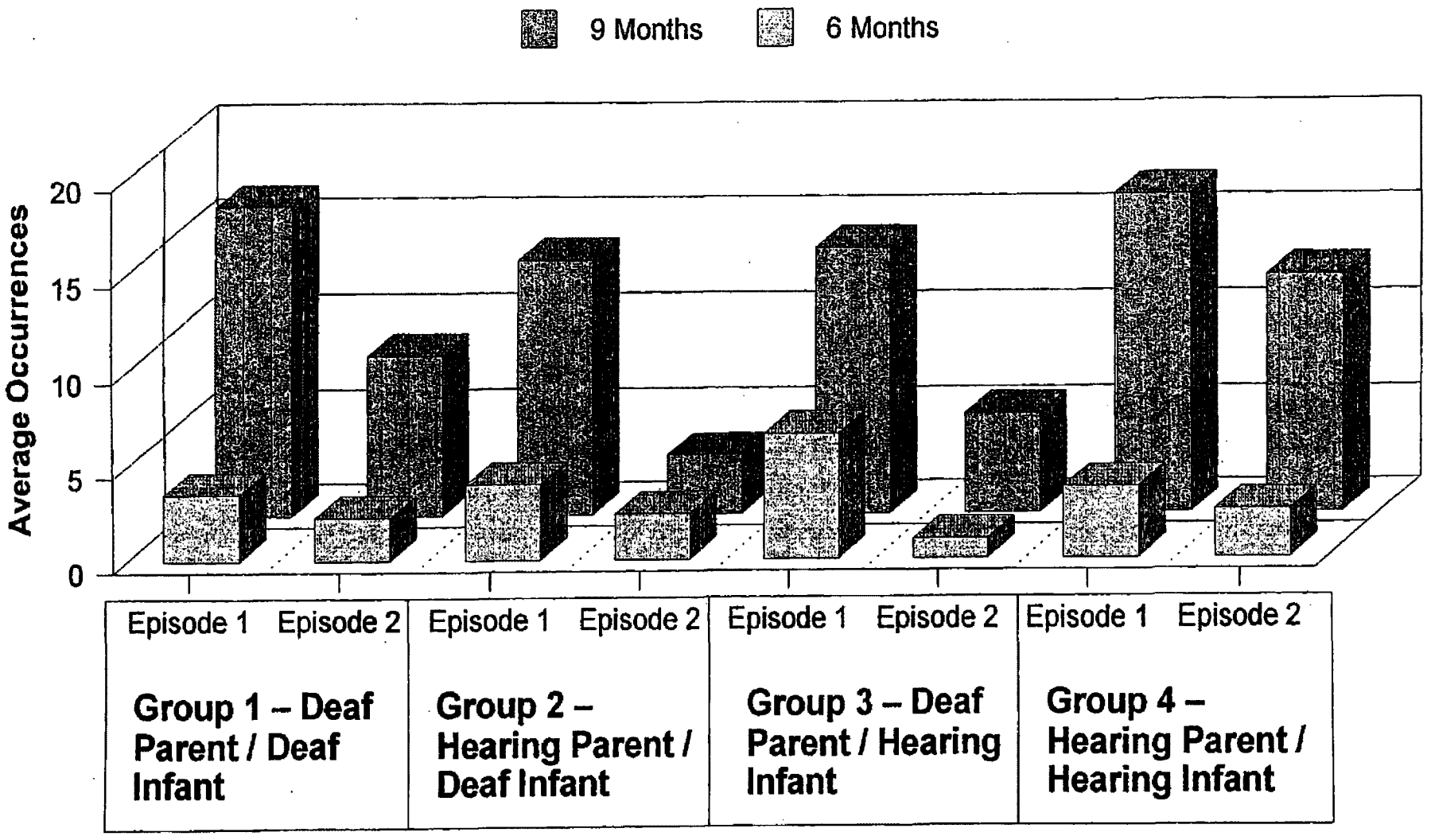

Figure Caption

Figure 4. Average frequencies of general motor behaviors emitted by mothers and infants in the four groups at the six and nine month period.

Event 4 – General Motor Behavior

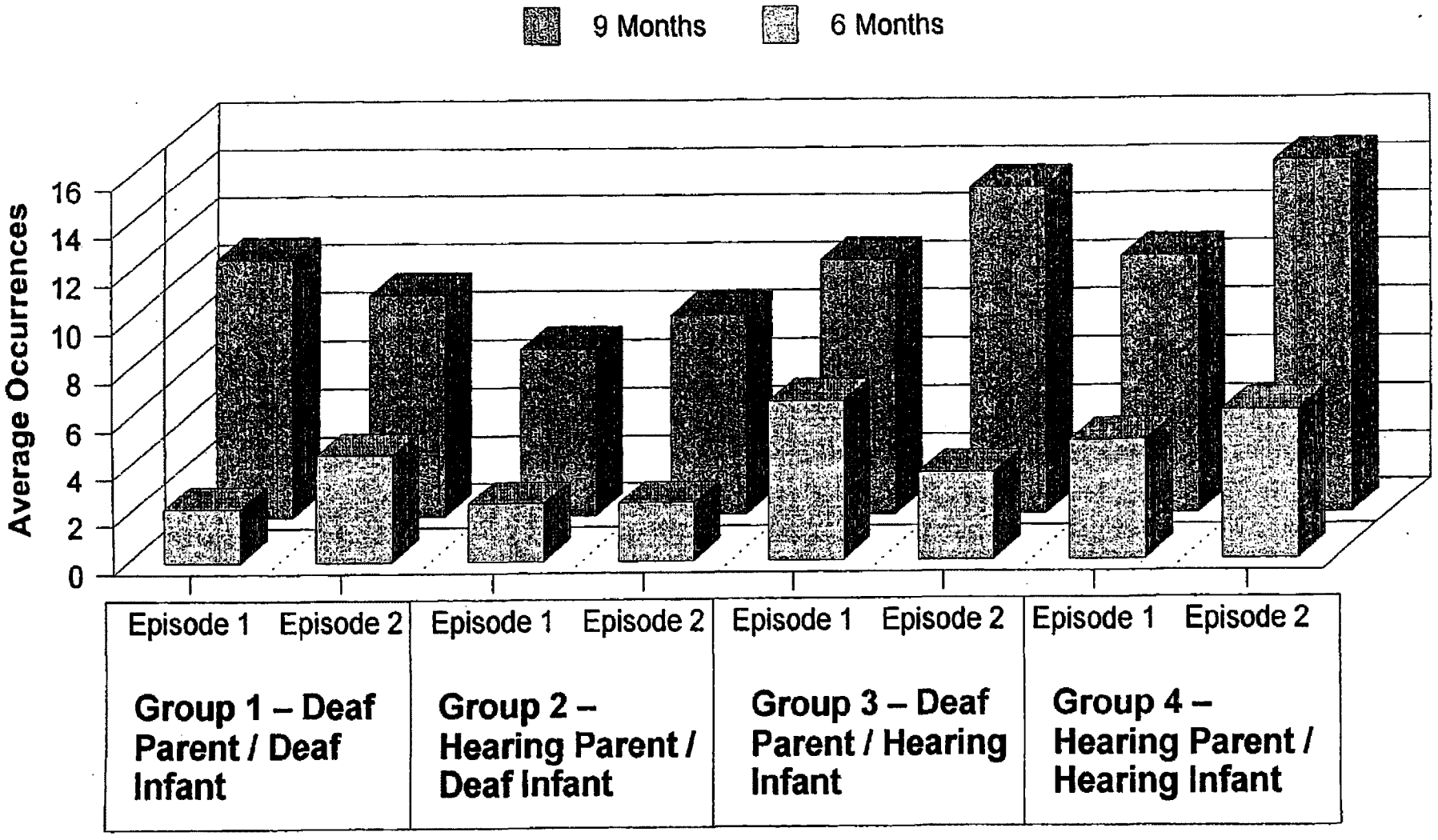

Figure Caption

Figure 5. Main Effect and Interaction terms of Hand-Finger analysis, suggesting changes within groups by Time and Episode.

			Average Number of Behaviors	Std. Error
Group 1 (Deaf Par., Deaf Inf.)	Time 1	Episode 1	5.000	1.93
		Episode 2	1.750	1.11
	Time 2	Episode 1	9.500	2.64
		Episode 2	12.750	2.60
Group 2 (Hear Par., Deaf Inf.)	Time 1	Episode 1	1.600	1.73
		Episode 2	1.400	.988
	Time 2	Episode 1	10.600	2.36
		Episode 2	5.400	2.36
Group 3 (Deaf Par., Hear Inf.)	Time 1	Episode 1	8.333	2.23
		Episode 2	3.667	1.28
	Time 2	Episode 1	15.333	3.05
		Episode 2	13.000	3.00
Group 4 (Hear Par., Hear Inf.)	Time 1	Episode 1	2.750	1.93
		Episode 2	3.000	1.11
	Time 2	Episode 1	7.500	2.64
		Episode 2	16.500	2.60

Figure Caption

Figure 6. Average frequencies of hand-finger behaviors emitted by mothers and infants in the four groups at the six and nine month period.

Event 5 – Hand Finger Behavior

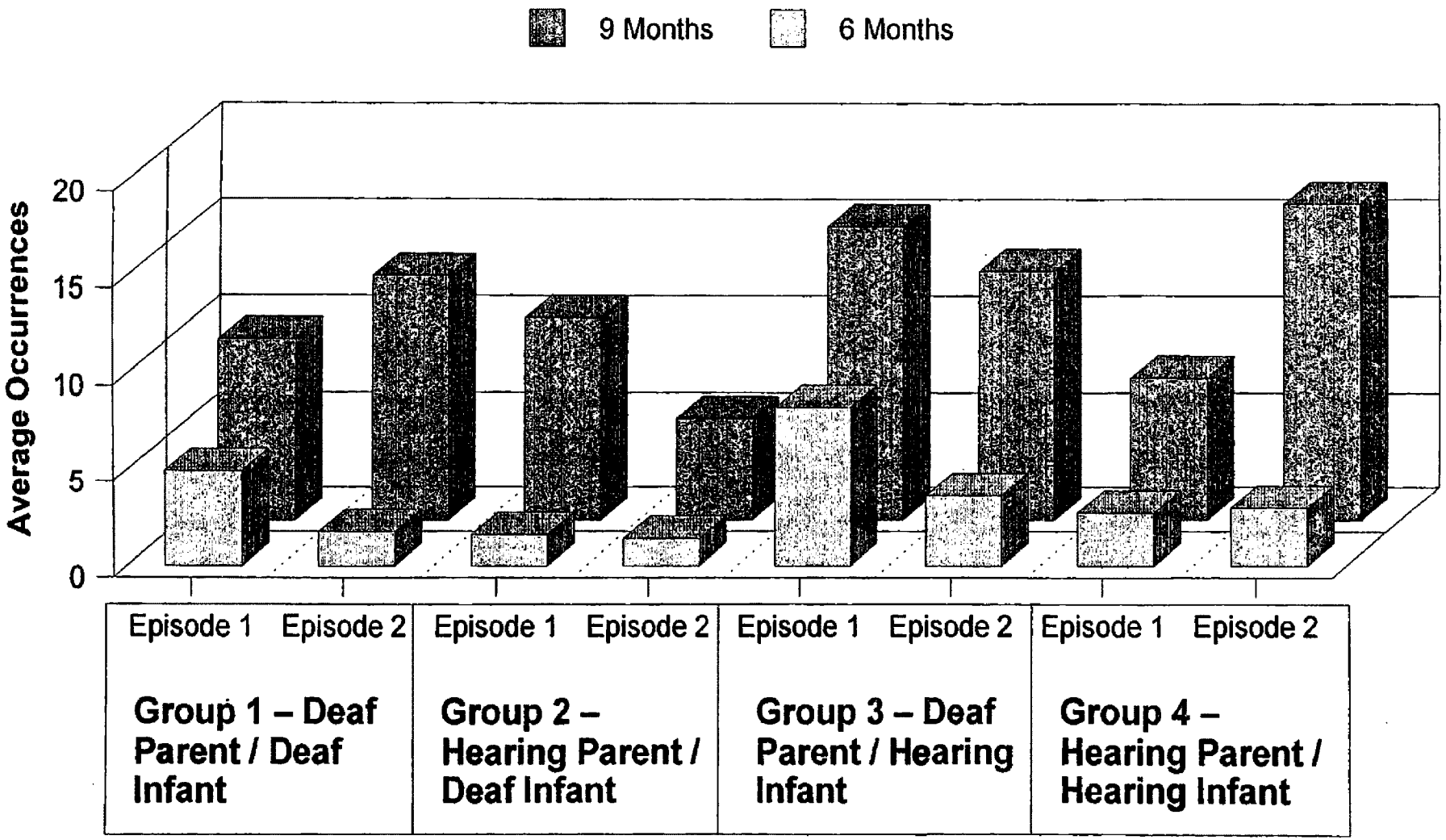

Figure Caption

Figure 7. Hand-finger behaviors emitted by interaction context in each group at the six and nine month period.